QUICK LAB

Descending Drops

TARGET SKILLS

- **Performing and recording**
- **Modelling concepts**
- **Analyzing and interpreting**

You can observe drops of water falling at terminal velocity through cooking oil in a test tube. Use an eye-dropper to carefully "inject" drops of cold water below the surface of the cooking oil. Measure the diameter of the drops and the speed of their descent.

Analyze and Conclude

1. Assume that the drops are spherical and are pure water with density 1.0 g/cm^3. Using the formulas for volume of a sphere $\left(V = \frac{4}{3}\pi r^3\right)$ and density $\left(D = \frac{m}{V}\right)$, calculate the mass of each drop.
2. Calculate the gravitational force and the retarding force on each drop.
3. What force(s) are retarding the downward force of gravity acting on the drops? Compare these forces to those acting on an object falling through air.
4. The curved sides of the test tube act like a lens, producing some optical magnification of objects inside. Describe in detail how this might be affecting your results.
5. How well does this activity model the movement of an object through air and the phenomenon of terminal velocity? Justify your answer.

1.3 Section Review

1. K/U Explain why your apparent weight is sometimes not the same as your true weight.
2. K/U Explain how Newton's third law applies to connected objects that are all pulled by one end.
3. C How does an Atwood machine make it easier to determine g (the acceleration due to gravity), rather than by just measuring the acceleration of a free-falling object?
4. C Suppose you are standing on a scale in a moving elevator and notice that the scale reading is *less* than your true weight.
   - **(a)** Draw a free-body diagram to represent the forces acting on you.
   - **(b)** Describe the elevator motion that would produce the effect.
5. K/U List the simplifying assumptions usually made about supporting cables and ropes. Why are simplifying assumptions needed?
6. K/U Two objects are moving in different directions. Under what circumstances can you treat this as a one-dimensional problem?
7. MC By the mid-1800s, steam-driven elevators with counterweights had been developed. However, they were not in common use until 1852, when Elisha Otis invented an elevator with a safety device that prevented the elevator from falling if the cable broke. How do you think that the invention of a safe elevator changed modern society?
8. C Describe a situation in which you could be standing on a scale and the reading on the scale would be zero. (**Note:** The scale is functioning properly and is accurate.) What is the name of this condition?